(e) selecting progeny which phenotypically resemble the commercial parent plant and express the desired trait, thereby producing a commercial plant with the desired trait.

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38. (Amended) The method of claim 37, wherein said mutation-inducing agent is a chemical mutagen selected from the group consisting of ethyl methanesulfonate (EMS), methyl methanesulfonate (MMS), methyl-N-nitrosourea (MNU), and bleomycins.

39. (Amended) The method of claim 37, wherein said mutation-inducing agent is irradiation selected from the group consisting of UV, γ-irradiation, X-rays, and fast neutrons.

40. (Amended) The method of claim 37, wherein said population of miniature plants is a population of miniature tomato plants.

REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 1-45 are in this case. Claims 9-11, 18-21, 26-31, 33-36 and 45 were withdrawn under a restriction requirement as drawn to a non-elected invention. Claims 1-8, 12-17, 22-25, 32 and 37-44 have been rejected. Claims 2, 3, 14-17, 23 and 25 have been objected to. Claims 3-6, 12, 13, 15-17, 22-25, 32 and 41-44 have now been canceled. Claims 1, 3, 14 and 37-40 have now been amended.

Claim Objections

The Examiner has objected to claims 2, 3, 14-17, 23 and 25 because these claims read upon a non-elected group. Claims 3, 15-17, 23 and 25 have now been cancelled rendering moot the Examiners objections with respect to

these claims. Claim 2 has now been amended and is now directed at the type of miniature plants utilized and claim 14 has now been amended per Examiner's suggestions thereby overcoming objections with respect to these claims.

35 U.S.C. § 112, First Paragraph, Rejections

The Examiner has rejected claims 1, 2, 4-8, 12, 14-17, 22-25 and 37-44 under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

The Examiner's rejections are respectfully traversed. Claims 4-6, 12, 15-17, 22-25 and 41-44 have now been cancelled rendering moot the Examiner's rejections with respect to these claims. Claims 1, 2, 14 and 37-40 have now been amended.

In particular, the Examiner points out that while the specification is enabling for mutant miniature plants made with *L. esculentum* and commercial *L. esculentum* plants made with said miniature mutant plants it does not provide reasonable enablement for any plant species or cultivar other than *L. esculentum*.

The present invention relates to the use of mutagenized miniature plants for screening and identifying commercially important traits which can be bred into sexually compatible plants which are preferably utilized in commercial agriculture.

It should be noted that since the methodology of the present invention does not necessary involve the generation of miniature plants but rather the utilization of such plants for selection of commercially important traits, it is not important how such plants are generated but rather that true miniature plants are utilized in mutagenesis and breeding.

Utilization of suitable miniature plants (i.e., those characterized by a uniform reduction in size as well as other characteristics) is well within the capabilities of the ordinarily skilled artisan.

Since the present invention relates to methodology which utilizes miniature plants, it is in practice, limited to those plants species having miniature varieties. Since it does not attempt to claim generation of a miniature plant, but simply a method of utilizing available miniature plants, the present methodology is not limited to the miniature plants exemplified in the specification but rather to any miniature plant characterized by uniformly reduced size in comparison to a commercial plant of the same species (the definition of a miniature plant). In addition, the miniature plant should be able to produce viable seeds or tubers at a plant density of at least ten-fold higher than standard growth conditions used for a commercial plant of the same species and capable of being crossed with a commercial plant of the same species.

It will be appreciated that selecting (and not generating) plants having such characteristics is well within the capabilities of the ordinarily skilled artisan, and as such the present methodology which encompasses mutagenesis and selection of miniature plants having desired traits (claim 1) and crossing such plants with commercial plants of the same species (claim 37) cannot be considered non-enabled by the instant specification since it simply teaches rapid and efficient selection of commercially important traits using mutagenized miniature plants, and optionally further transfer of such traits to commercially cultivated plants of the same species.

Independent claims 1 and 37 which relate to the above described methodology of the present invention have now been amended to recite "utilizing a population of miniature plants" thereby removing any unpredictability associated with the use of the term "providing" and further clarifying that generation of miniature plants is not necessarily a part of the claimed invention, but rather that the present invention is directed at using

miniature plants as a system for screening and breeding commercially important traits.

Independent claim 14, which is directed at a mutagenized miniature plant generated by the present methodology has now been amended to limit the miniature plant generated to a plant of the tomato species which is supported by the instant specification.

The Examiner further states that Applicant fails to disclose guidance which can be used to overcome sexual breeding barriers characteristic of some plants species.

Section (iii) of claims 1 and 37 recite the limitation "capability of being crossed with a commercial plant of the same species" which clearly limits the miniature plants utilized by the present invention to those capable of breeding with the commercial plant of the same species. Thus, the present invention does not require the ordinarily skilled artisan to engage in undue trial and error experimentation in order to establish breeding lines, but rather select and utilize miniature plants characterized by the limitations set forth in sections (i)-(iii) of claims 1 and 37. It will be appreciated that such selection is well within the capabilities of the ordinarily skilled artisan.

In conclusion, Applicant would like to reiterate that the present invention is not directed at generation of miniature plants, but rather to utilization of such plants (regardless if preexisting or newly generated) for the purpose of selecting and breeding commercially important traits. As described with respect to the prior art rejections argued below, the use of miniature plants for such purposes presents numerous advantages over prior art methodology.

In view of the above arguments, Applicant believes to have overcome the 35 U.S.C. § 112, first paragraph, rejections.

35 U.S.C. § 112, Second Paragraph, Rejections

The Examiner has rejected claims 2, 3, 6, 17, 40 and 44 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Claim 40 has now been amended and claims 2, 3, 6, 17 and 44 have now been canceled, rendering moot the Examiner's rejections with respect to these claims.

35 U.S.C. § 102 Rejections

The Examiner has rejected claims 1,2, 4, 7, 12, 14, 15, 22-24, 37-38 and 41-42 under 35 U.S.C. § 102(b) as being anticipated by Khush et al.

The examiner has also rejected claims 1,2, 4, 8, 12, 14, 15, 22, 23, 25, 37-38 and 41-42 under 35 U.S.C. § 102(b) as being anticipated by Lahiri et al.

The examiner has also rejected claims 1-6, 8, 12, 13, 14-17, 22, 23, 25 and 32 under 35 U.S.C. § 102(b) as being anticipated by Privalov et al.

The examiner has also rejected claims 1,2, 4, 5, 12, 14-16, 22 and 23 under 35 U.S.C. § 102(b) as being anticipated by Damasco et al.

The Examiner's rejections are respectfully traversed. Claims 3-6, 12, 13, 15-17, 22-25, 32 and 41-44 have now been cancelled rendering moot the Examiner's rejections with respect to these claims. Claims 1, 2, 14 and 37-40 have now been amended.

The Examiner's states that the prior art cited above teaches of various miniature plant species and the use thereof in the production of mutant plant populations and the introgression of commercially important traits from the mutagenized miniature plants to commercial plants.

Although the prior art cited by the Examiner teaches methodology of trait selection and breeding it differs from the present invention in that it utilizes dwarf plants and not miniature plants.

Indeed all of the "miniature" plants described in the prior art cited by the Examiner are in fact dwarf plants which, as is well known in the art, are distinct both morphologically and physiologically from miniature plants.

The term "dwarf" refers to a reduction in plant height with no reduction in the size of leaves, inflorescences or fruits. The internodes (the stem segments between the nodes and the sites of leaf emergence from the stem) of dwarf plants are reduced in size, however, the size of the leaves or fruits are similar to that of the corresponding wild type plant.

Dwarf mutants are often generated by altered metabolism of growth factors such as Gibberellins or Brassinosteroids. One well known example is the dwarfing genes of Cereals (Rht=Reduced height, or Gai=Gibberellic acid insensitive) that have contributed to the green revolution (Peng et al. 1999, full text enclosed herewith). These genes cause a reduced plant height that enables to increase yield without lodging of the plants since heavy spikes on a tall stem are more likely to lodge in windy or rainy weather.

Today, most wheat cultivars, and several rice cultivars are dwarf or semi-dwarf plants. These plants are characterized by shorter stems and wild type leaves and spikes and as such, these plants cannot be grown at a density higher than the normal (wild type) plants. Similarly, the tomato *Dwarf* gene, which controls plant height via brassinosteroids, affects the stem length and not the leaf size of such plants (Bishop et al. 1996, full text enclosed herewith) and as such, dwarf tomato varieties cannot be grown at a density higher than the normal (wild type) plants.

Thus, dwarf plant lines do not offer any advantages in cultivation density over wild type plants and as such, they are not suitable for high-throughput screening of mutants.

In sharp contrast, miniature plants, which are defined as being of a "reduced scale", (i.e., a small copy of the wild type plant) are highly suitable for high throughput screening of mutants.

The present invention utilizes miniature varieties, such as Micro-Tom, which have a balanced reduced size, namely a proportional reduction in the height of the plant as well as in its leaves and fruits.

The use of miniature varieties is advantageous since such varieties can be grown at a much higher plant density than wild type or dwarf varieties. For example, the Micro-Tom tomato variety can be grown at a plant density that is 1-3 orders of magnitude higher than normal tomatoes (Meissner et al. 1997, full text enclosed herewith).

This characteristic of miniature plants enables to carry high throughput screens for commercially important traits, a task which cannot be accomplished using dwarf plant lines.

As is illustrated in the Examples section of the instant application, the use of miniature plants enabled screening of tens of thousands of mutants in a small and confined space (greenhouse or nethouse) while fields of tens of acres would be required to screen similar wild type or dwarf populations.

To further distinct the present invention from the prior art, Applicant has elected to amend independent claims 1 and 37 to now read "uniformly reduced size in comparison to a commercial plant of the same species" thereby further emphasizing that the plants used by the present invention are miniature plants and not dwarf plants.

In view of the above remarks and claim amendments, it is applicant's strong opinion that the present invention is neither anticipated nor is it rendered obvious by the prior art.

35 U.S.C. § 102/103 Rejections

The Examiner has rejected claims 12-13 and 41-44 under 35 U.S.C. § 102(b) as being anticipated, or in the alternative under 35 U.S.C. § 103(a) as obvious over Scott et al.

The Examiner has rejected claims 12 and 41-44 under 35 U.S.C. § 102(b) as being anticipated, or in the alternative under 35 U.S.C. § 103(a) as obvious over Fideghelli et al.

The Examiner has rejected claims 1-2, 4-8, 12, 14-17, 22-25 and 37-44 under 35 U.S.C. § 103(a) as obvious over Khush et al. in view of Fideghelli et al.

The Examiner has rejected claims 1-8, 12-17, 22-25, 32 and 37-44 under 35 U.S.C. § 103(a) as obvious over Khush et al. in view of Scott et al.

The Examiner's rejections are respectfully traversed. Claims 3-6, 12, 13, 15-17, 22-25, 32 and 41-44 have now been cancelled rendering moot the Examiner's rejections with respect to these claims. Claims 1, 2, 14 and 37-40 have now been amended.

Arguments with respect to the use of dwarf Vs. miniature plants are set forth hereinabove.

Although the prior art describes numerous miniature plant varieties (e.g., the Micro-Tom variety described by Scott et al. and Meissner et al.), none of the prior art references cited by the Examiner describe or suggest the use of miniature varieties in screening for commercially important mutations. In fact, the prior art cited by the Examiner does not point out the advantages of miniature varieties in high throughput screening of mutations and as such, the prior art of record would not motivate one of ordinary skill in the art to replace the dwarf varieties of prior art screening methods with miniature plant varieties.

Such lack of motivation is evident from the absence of literature describing mutant screening methods utilizing miniature plant varieties. In fact, not a single article suggesting the use of miniature varieties for screening mutations for commercially important traits has been published prior to filing of the instant application in spite of the fact that screening methodology utilizing dwarf plants and miniature varieties have both been known for over 15 years.

In view of the above remarks and claim amendments, it is applicant's strong opinion that the present invention is neither anticipated nor is it rendered obvious by the prior art.

In view of the above amendments and remarks it is respectfully submitted that claims 1, 2, 7-8, 14 and 37-40 are now in condition for allowance. Prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,

Sol Sheinbein
Attorney for Applicant
Registration No. 25,457

Date: August 8, 2002.

Encl.:
Three months extension fee
Articles by:
Bishop et al.
Hua et al.
Meissner et al.
Penge et al.
Scott et al. (1984; 1989)

VERSION WITH MARKING TO SHOW CHANGES MADE

In the claims:

1. (Amended) A method ~~for~~ of ~~selecting~~ generating a mutant miniature plant having a desired trait, the method comprising ~~the steps of~~:

(a) ~~providing~~ utilizing a population of miniature plants ~~, wherein said miniature plants have~~having the following characteristics: (i) uniformly reduced size in comparison to a commercial plant of the same species; (ii) maturation to produce viable seeds or tubers at a plant density of at least ten-fold higher than standard growth conditions used for a commercial plant of the same species; and (iii) ~~capable~~ capability of being crossed with a commercial plant of the same species;

(b) ~~generating mutant miniature plants in said miniature plant population by~~ treating said miniature plants with a mutation-inducing agent to produce a ~~mutagenized~~ mutant miniature plant population; and

(c) selecting a mutant miniature plant having ~~said~~ the desired trait ~~within~~ from said ~~mutagenized~~ mutant miniature plant population.

2. (Amended) The method of claim 1, wherein said population of miniature plants is ~~generated by natural or induced mutation, by genetic engineering, or by treatment with plant growth factors~~a population of miniature tomato plants.

14. (Amended) A mutant miniature tomato plant population wherein ~~a~~ each miniature tomato plant of said miniature tomato plant population ~~has the following characteristics: (i) reduced size in comparison to a commercial plant of the same species; (ii) matures to produce viable seeds or tubers at a density of at least ten-fold higher than standard growth conditions used for a commercial plant of the same species; (iii) capable of being crossed~~

~~with a commercial plant of the same species; and (iv)~~ carries in a genome of its cells a distinct mutation induced by an agent selected from the group consisting of a chemical mutagen, or irradiation~~, and a mobile DNA sequence~~.

37. (Amended) A method ~~for~~ of producing a ~~mutant population of~~ ~~a~~ commercial plant with a desired trait, ~~which comprises the steps of~~the method comprising:

(a) utilizing a population of miniature plants having the following characteristics: (i) uniformly reduced size in comparison to a commercial plant of the same species; (ii) maturation to produce viable seeds or tubers at a plant density of at least ten-fold higher than standard growth conditions used for a commercial plant of the same species; and (iii) capability of being crossed with a commercial plant of the same species;

(b) treating said miniature plants with a mutation-inducing agent to produce a mutant miniature plant population;

(c) selecting a mutant miniature plant having the desired trait from said mutant miniature plant population;

(~~a~~d) crossing ~~a~~ said mutant miniature plant selected ~~according to the method of claim 1 having said desired trait,~~ in step (c) with a commercial plant of the same species; and

(~~b~~e) selecting progeny which phenotypically resemble the commercial parent plant and express ~~said~~ the desired trait, thereby producing a commercial plant with the desired trait.

38. (Amended) The method of claim 37, wherein said mutation-inducing agent is a chemical mutagen selected from the group consisting of ethyl methanesulfonate (EMS), methyl methanesulfonate (MMS), methyl-N-nitrosourea (MNU), and bleomycins~~commercial plant is used to produce food, fiber or flowers~~.

39. (Amended) The method of claim ~~38~~37, wherein said mutation-inducing agent is irradiation selected from the group consisting of UV, γ-irradiation, X-rays, and fast neutrons ~~commercial plant is a plant which produces a berry type fruit or a plant of the Solanaceae family~~.

40. (Amended) The method of claim ~~39~~37, wherein said population of miniature plants is a population of miniature tomato plants~~commercial plant produces a berry type fruit selected from tomato, grape, prune, eggplant citrus fruits, apple~~.

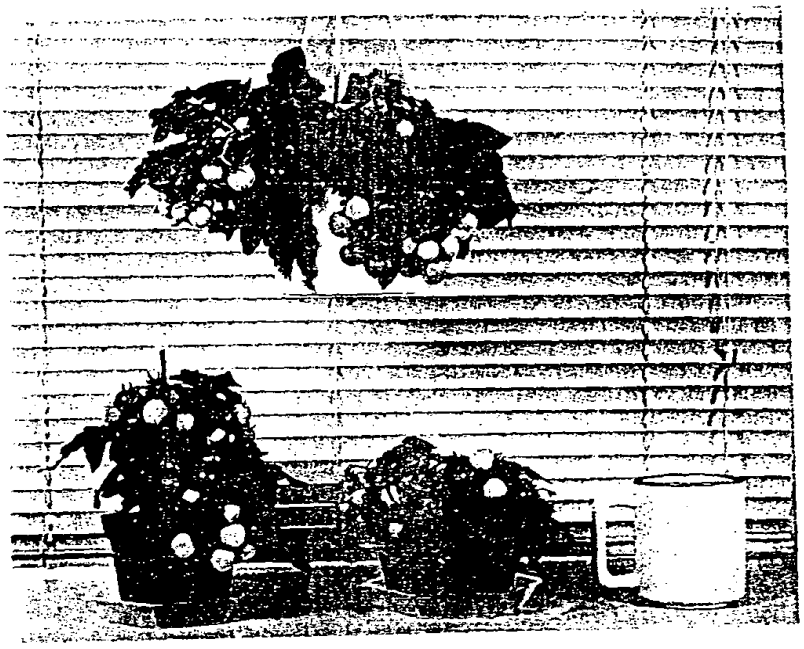
December 1989

Circular S-370

MICRO-TOM

A Miniature Dwarf Tomato

J.W. Scott and B.K. Harbaugh



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